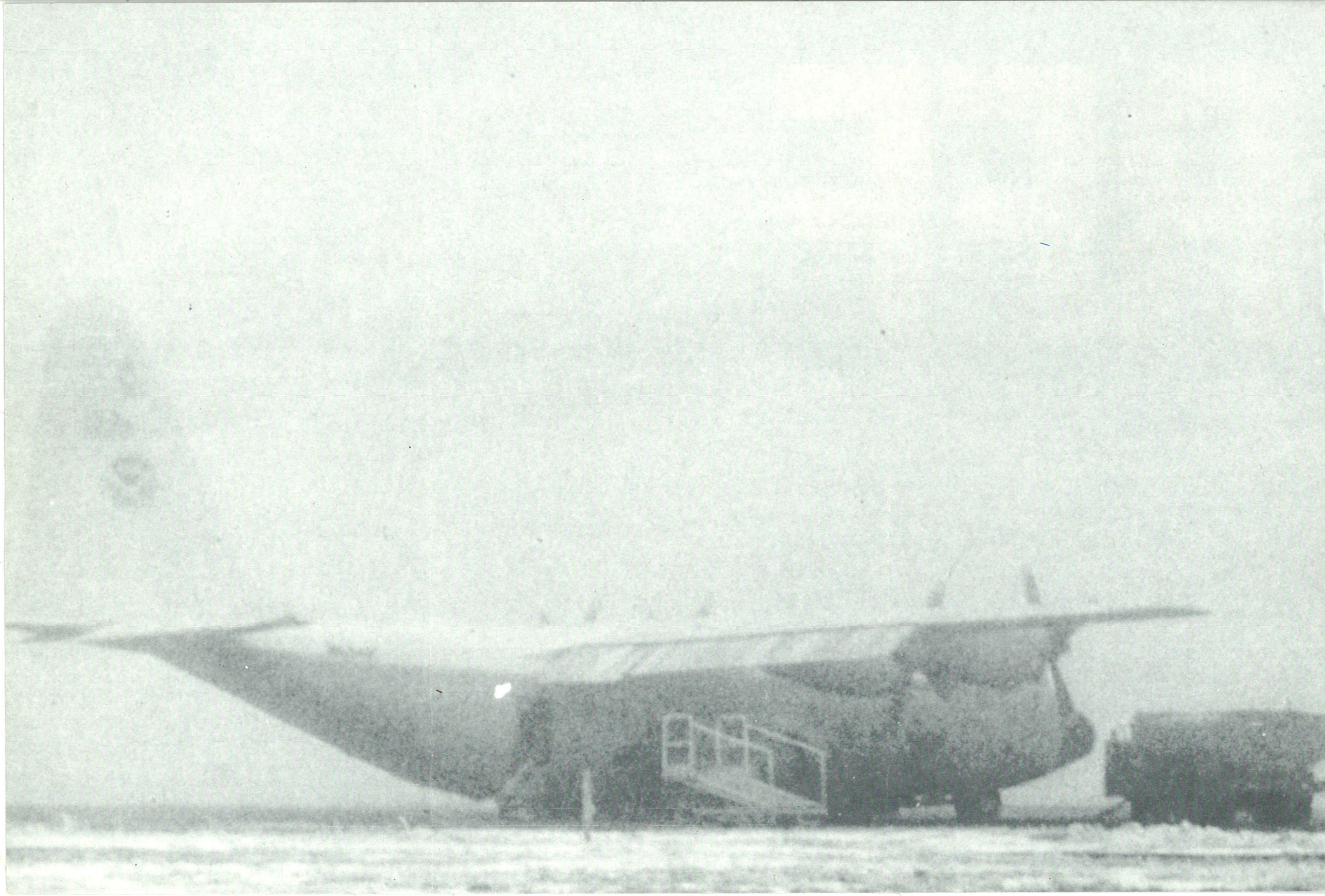
RFF

The Research Flight Facility

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Environmental Research Laboratories



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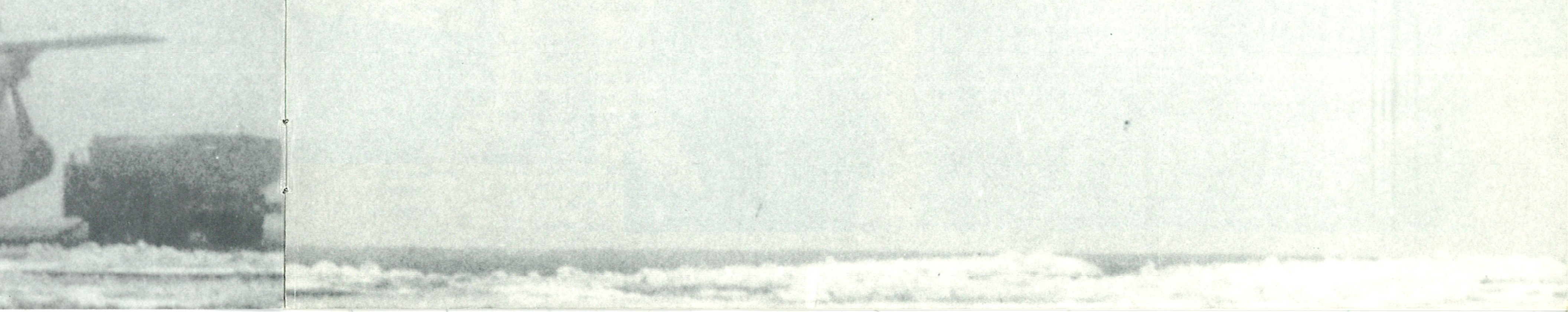
Atmospheric research must finally be conducted in the laboratory of the sky, a laboratory difficult to enter, full of events which are difficult to read. In NOAA, the U.S. Commerce Department's National Oceanic and Atmospheric Administration, entry to this natural laboratory is gained by way of the superbly instrumented aircraft of the Research Flight Facility, the aeronautical arm of NOAA's Environmental Research Laboratories.

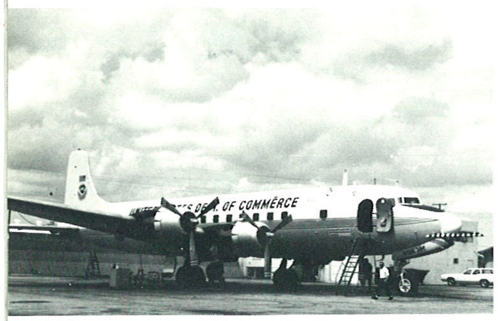
With roots going back to the research aircraft operated by the former U.S. Weather Bureau, the Research Flight Facility's aircraft and uniquely experienced crews have flown thousands of sorties into the world's most difficult weather—hurricanes, winter storms, tropical cumuli, the Indian monsoon circulation, and the intricate mixtures along the Intertropical Convergence Zone. And they have been excellent classrooms. Much of the precise information that exists on these atmospheric systems and on beneficial weather modification techniques has come from the hours-long ordeals by water, wind, and weather flown by the Research Flight Facility.

They have also been centerpieces in the series of major, international experiments aimed at obtaining an improved understanding of global weather processes. These include the International Indian Ocean Expedition (IIOE) of 1963 and 1964, the Barbados Oceanographic and Meteorological Experiment (BOMEX) of 1969, the International Field Year for the Great Lakes (IFYGL) of 1971, and the Global Atmospheric Research Program's Atlantic Tropical Experiment (GATE) of 1974.

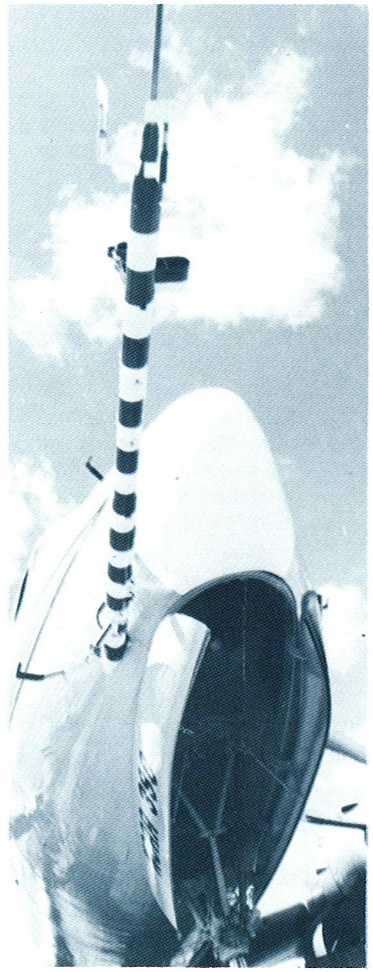
At present, the Facility operates two aircraft, a Lockheed WC-130B **Hercules** and a Douglas DC-6A. Both airplanes are four-engined, long-range aircraft capable of carrying out a wide variety of environmental research assignments, anywhere in the world. In 1975, these airplanes will be joined by the first brand-new aircraft ever purchased by the Department of Commerce, a Lockheed WP-3D, built and instrumented with the NOAA mission in mind.



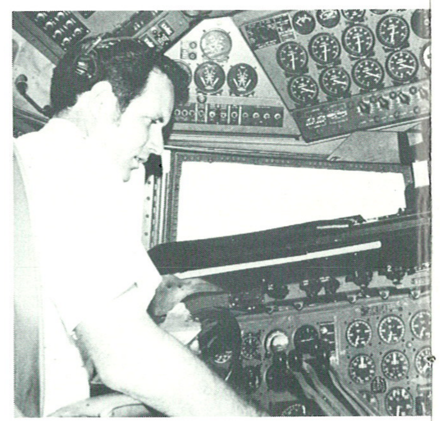
The piston-engined DC-6 is best suited to operations in the low-to-middle levels of the troposphere. It carries a basic instrumentation system for the airborne measurement of temperature, humidity, pressure, winds, position, and related parameters, and a turbulence system assembled and installed in 1970 by the Research Flight Facility and the Boundary Layer Dynamics Group. (Both units are part of the Environmental Research Laboratories' Weather Modification Program Office.) This gust probe system measures the parameters necessary to determine the aircraft's motion with respect both to the ground and to the air through which it is flying. The end product is a calculation of how much heat and moisture is being added to or subtracted from the sub-cloud layer of the atmosphere probed by the airplane, an important consideration in understanding cloud structure and dynamics.

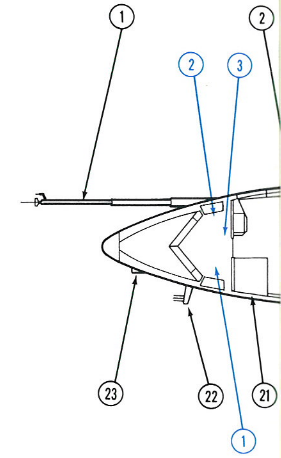


The airplane is also equipped with a laser wave-height measuring system and infrared sea-surface temperature radiometer for oceanographic measurements. The DC-6 data system was modified in 1974 to include a mini-computer and video readout; an Omega-updated inertial navigation system was also added to improve position and wind measurements. Side, nose, radar, and vertical cameras provide time-lapse photographic coverage of aircraft missions.



The aircraft has been used extensively in NOAA's weather modification projects, including Great Lakes winter storm modification, Project Stormfury, and the Florida Cumulus Experiments. Two racks mounted in pods suspended below each wing permit the DC-6 to carry 208 silver iodide pyrotechnic canisters.





Personnel

1. Pilot
2. Co-pilot
3. Flight engineer
4. Mission scientist
5. Mission scientist
6. Mission scientist
7. Radio operator
8. Electronics technician
9. Photo-optical operator
10. Mission scientists
11. Mission scientists
12. Data system operator
13. Navigator
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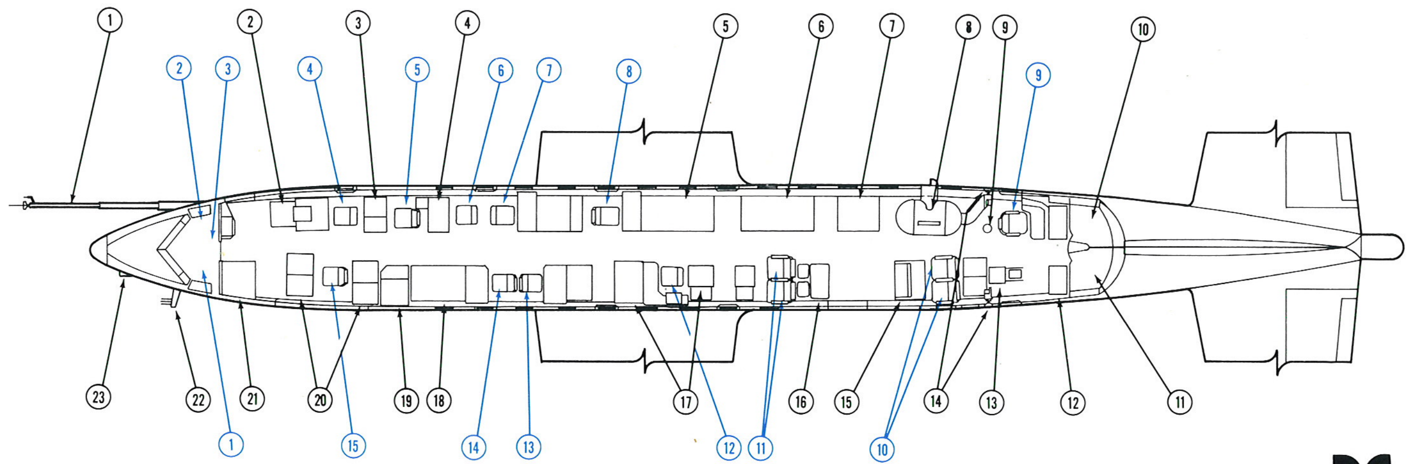


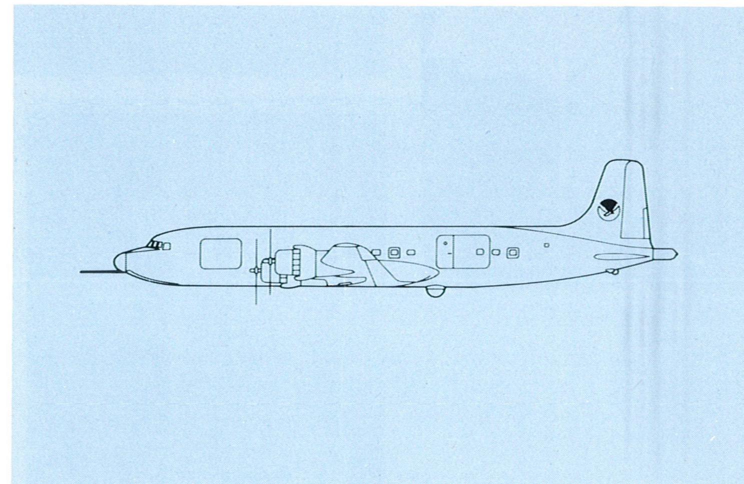
DC-6A

Personnel

1. Pilot
2. Co-pilot
3. Flight engineer
4. Mission scientist
5. Mission scientist
6. Mission scientist
7. Radio operator
8. Electronics technician
9. Photo-optical operator
10. Mission scientists
11. Mission scientists
12. Data system operator
13. Navigator
14. Flight director
15. Mission scientists

Equipment

1. Gust probe
2. 115 VAC 60 Hz Inverter rack
3. Cloud physics station
4. Cloud physics station (nuclei)
5. Work table
6. Equipment racks
7. Power distribution panel and rack
8. Turbine powered alternator
9. B-3 drift meter
10. Darkroom
11. Lavatory
12. RDR-ID radar rack
13. Laser altimeter
14. 35 mm side cameras
15. Laser wave height measuring system
16. Emergency radios and 20-man raft
17. Data system
18. Equipment racks
19. Galley
20. Gust probe system
21. Aircraft radio rack
22. Hot film anemometer
23. 16 mm forward camera



The turboprop-powered WC-130B **Hercules** is a fast-climbing airplane able to operate comfortably at the 25,000 to 30,000 foot (7,500 to 9,000 meter) level, which is the region of most interest to cloud physicists. The NOAA aircraft carries, in addition to the basic instrumentation needed to measure weather elements and position, a wide variety of cloud physics instrumentation for sampling the interiors of clouds. These devices include an infrared air temperature radiometer, ice-

nuclei counter, aerosol detector, liquid water content sensors, and a hydrometeor foil sampler. In 1974, the aircraft was modified to carry the Airborne Weather Reconnaissance System (AWRS), a minicomputer-centered airborne meterological data system developed for the Air Weather Service by Kaman Aerospace Corp. The C-130 is also equipped to launch standard dropsondes as well as the Omega dropsonde, which senses temperature, humidity, pressure, and position (or winds) as it falls from the aircraft to the surface; the position-sensing capability uses an Omega-updated inertial navigation system. Side, nose, radar, and vertical cameras provide time-lapse photographic coverage of aircraft missions.

The C-130 has flown numerous missions in support of the National Aeronautics and Space Administration's Skylab earth-sensor experiments, and has been extensively used in the development of new remote-sensing techniques developed for eventual use aboard satellites. It has also been heavily involved in weather modification experiments. The airplane carries four seeding racks on each side of the fuselage, containing a total of 416 silver-iodide flares. A pushbutton firing mechanism located at the visiting scientist station on the flight deck and connected to an electricalsequencer is used to ignite and launch the flares during cloud penetrations.

C-130B

Personnel

1. Pilot
2. Co-pilot
3. Flight engineer
4. Navigator
5. Mission scientist
6. Flight director
7. Photo-optical operator
8. Passenger
9. Omega dropsonde operator
10. Crew
11. Crew
12. Passengers

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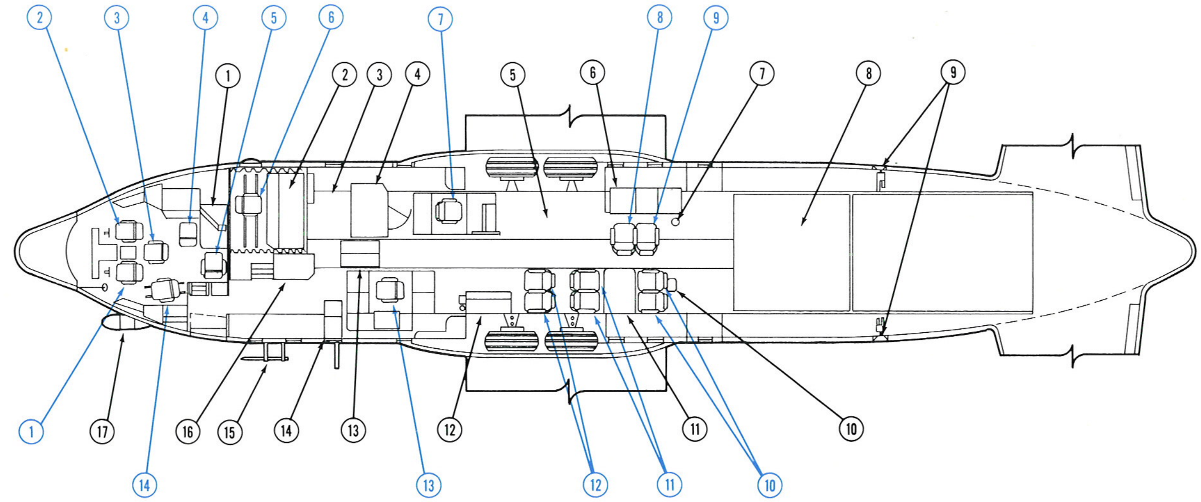
C-130B

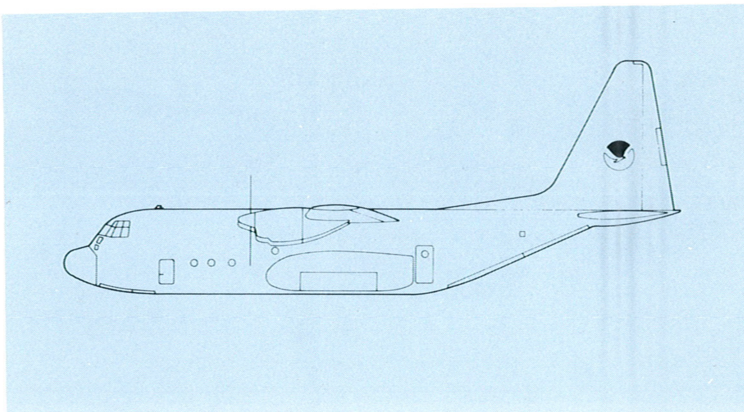


Personnel

1. Pilot
2. Co-pilot
3. Flight engineer
4. Navigator
5. Mission scientist
6. Flight director
7. Photo-optical operator
8. Passenger
9. Omega drop-sonde operator
10. Crew
11. Crew
12. Passengers
13. Cloud physics station
14. Mission scientist

Equipment

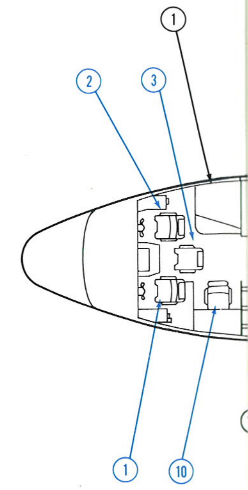
1. Remote data display
2. Airborne Weather Reconnaissance System (AWRS)
3. Power distribution panel
4. Lavatory
5. Baggage/Cargo tiedown area
6. Omega drop-sonde racks
7. Omega drop-sonde chute
8. Cargo ramp (cargo tiedown area)
9. 35 mm side cameras
10. Type MA-1 dropsonde chute
11. Work table
12. Galley
13. Vertical camera bay
14. Formvar system
15. Lyman-Alpha probe
16. AWRS equipment rack
17. 16 mm forward camera



The WP-3D **Orion** is scheduled to join the Research Flight Facility in mid-1975, and be instrumented by the summer of 1976. The P-3D is the most recent descendant of a design familiar to most air travelers as the turboprop **Electra,** although the resemblance is superficial—the **Orion** series is a tougher, more powerful airplane than its civilian ancestor, developed to carry out the U.S. Navy's anti-submarine warfare and weather reconnaissance missions. Since 1959, more than 400 P-3D's have been built by the Lockheed-California Company in Burbank, and today serve with the U.S. Navy and the defense forces of Australia, Norway, Spain, and New Zealand.

The WP-3D can operate effectively from sea level to 30,000 feet (9,100 meters), loiter at speeds between 180 and 225 knots (335 and 415 kilometers per hour), and attain dash speeds in excess of 400 knots (740 kilometers per hour). In its NOAA configuration, the aircraft will lend its capabilities to the special needs of environmental research and weather modification. The principal visible differences between the NOAA craft and its Navy cousins will be two additional bubble windows in the fuselage, an additional scientist station window aft of the pilot's station, and wing fittings for external instrumentation and seeding-agent stores. The aircraft mounts a C-band radar in a large blister radome just aft of the nosewheel well, a weather radar in the nose radome, and an X-band radar in a shortened tail radome. The NOAA WP-3D will carry the Research Aircraft Meteorological System (RAMS), an advanced data system being developed by NOAA's Instrumentation Task Force, another element in the Environmental Research Laboratories' Weather Modification Program Office.

WP-3D



Personnel

1. Pilot
2. Co-pilot
3. Flight engineer
4. Navigator
5. Passengers
6. Mission scientist
7. Camera control station
8. Passengers
9. Flight director
10. Chief Scientist

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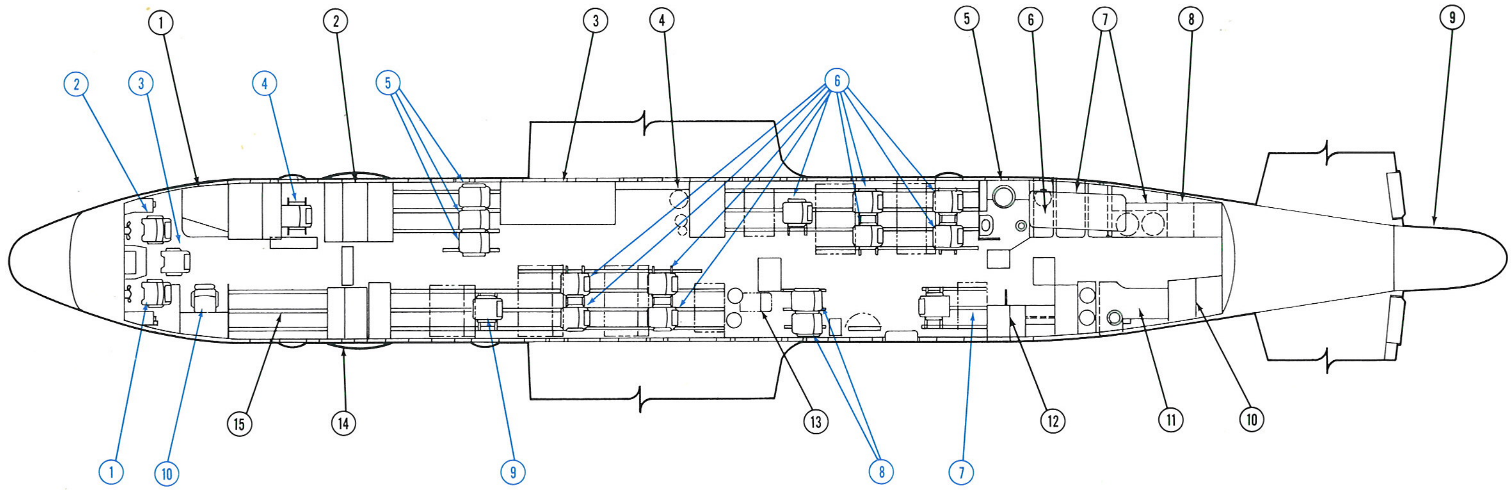
P-3D



Personnel

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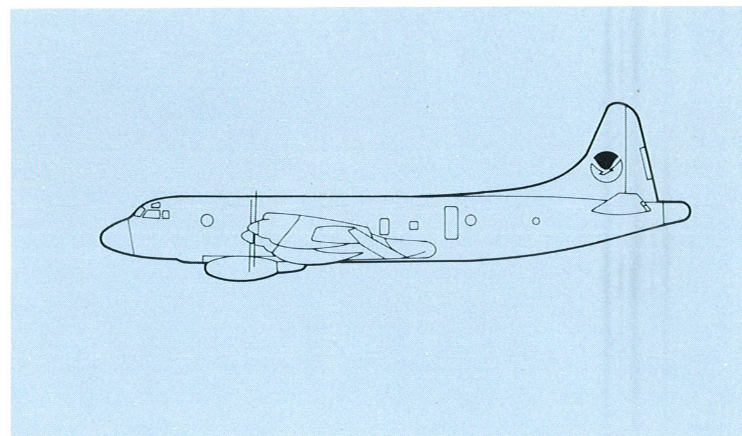
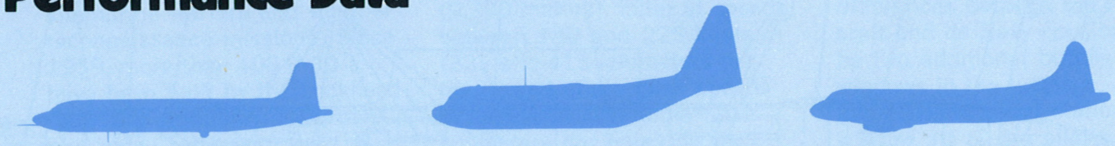
10. Chief Scientist

Equipment

1. Forward electrical load center
2. Equipment racks
3. Main electrical load center
4. Safety equipment
5. Lavatory
6. Dinette
7. Overhead bunks
8. Electrical technician work area and storage
9. X-band radome
10. Equipment racks
11. Galley
12. Equipment racks
13. Safety equipment
14. Bottom-mounted C and S band radome
15. Cloud physics area



NOAA Aircraft Performance Data



	DC-6A	C-130B	WP-3D
PRODUCTION DATE	1958	1958	1974
NOAA ACQUISITION DATE	1960	1970	1974
DIMENSIONS			
Wing Span	117'-6"	132'-7"	99'-7"
Length	106'-10"	97'-9"	104'-3"
Height	28'-8"	38'-6"	33'-8"
ENGINES	4-P & W 18 CYL R-2800	4-ALLISON T-56-A-7 TP	4-ALLISON T-56-A-14 TP
TAKE-OFF HORSEPOWER EACH ENGINE	2,400 [1]	3,755	4,600
MAXIMUM TAKE-OFF WEIGHT (POUNDS)	103,800 [1]	135,000	135,000
NORMAL SPEED, TRUE (KNOTS) [2]	220	280	325
TURBULENT AIR SPEED (KNOTS) [3]	170	180	220
MAXIMUM USEABLE FUEL (POUNDS)	26,400	45,240	62,560
FUEL RESERVE TIME (HOURS)	2.5	2.0	2.0
ENROUTE TIME (HOURS)			
500 feet Altitude	11.00	6.5	8.0
10,000 Feet Altitude	10.5	8.0	9.0
20,000 Feet Altitude	—	9.0	10.0
MAXIMUM RANGE (MILES) [4]			
500 Feet Altitude	2,400	1,700	2,250
20,000 Feet Altitude	1,500	2,400	3,250
MAXIMUM RANGE (NAUTICAL MILES) [5]	—	2,700	4,200

1. With 100/130 octane fuel. 2. At optimum altitude. 3. Severe weather penetration. 4. Maximum range, — four engine cruise condition. 5. Step climb condition.

The Environme Research Laboratori

NOAA's Environmental Laboratories, headqua Boulder, Colorado, con broad investigations o physical environment a around the country. Th Fla.-based Research F Facility is one of sever attached to the Labora Weather Modification F Office. Others, also ba Miami, include the Nat Hurricane Research La and Experimental Mete Laboratory. In Boulder office also includes the mentation Task Force, the objective of provid advanced research dat for the P-3 aircraft, an Boundary Layer Dynar Group, which studies pheric boundary layer structure and turbulen airborne remote-sensin techniques.

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The Environmental Research Laboratories

NOAA's Environmental Research Laboratories, headquartered in Boulder, Colorado, conduct broad investigations of man's physical environment at facilities around the country. The Miami, Fla.-based Research Flight Facility is one of several units attached to the Laboratories' Weather Modification Program Office. Others, also based in Miami, include the National Hurricane Research Laboratory and Experimental Meteorology Laboratory. In Boulder, this office also includes the Instrumentation Task Force, which has the objective of providing an advanced research data system for the P-3 aircraft, and the Boundary Layer Dynamics Group, which studies the atmospheric boundary layer microstructure and turbulence using airborne remote-sensing techniques.

Besides the Weather Modification Program Office and its specialized elements, the Environmental Research Laboratories include major oceanographic facilities in Miami and Seattle; centers for atmospheric research in Boulder and Norman, Oklahoma; air-pollution research laboratories at various locations nationwide; a Boulder laboratory developing electromagnetic and acoustic sensors for environmental observation; tsunami research facilities in Hawaii; a network of climate-watching observatories; an atmosphere- and ocean-simulating computer laboratory in Princeton, New Jersey; a sun and space-environment monitoring laboratory in Boulder; and a Great Lakes research laboratory in Ann Arbor, Michigan.


NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NOAA
U.S. DEPARTMENT OF COMMERCE
NOAA/PA 74008
1974

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